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SWINE FEEDING INVESTIGATIONS

ERNEST E. FISH

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SWINE FEEDING INVESTIGATIONS

by

[illegible] E. FISH

A

THESIS

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FOREWORD

The value feeding investigations reported in this paper, may be divided into two distinct fields with subdivisions under each.

I. Winter feeding experiments for a comparison of following rations:

1. Corn and wheat cut feed.
2. Alfalfer timothy versus pasture herbage.
3. Mixed feed as a pasture supplement.
4. Rations containing various combinations of feeds advocated in general practice.

II. Winter forage crop experiments to compare the feeding values of forages:

1. Clay-grass pasture.
2. Hay hoed forage.
3. Roots forage.
4. Cereals peas, oats and rape forage.
5. Hay not fed.

Each part is complete in itself, and is a report of work conducted by the author to furnish important and much needed information to the live stock grain feeder.

INTRODUCTION.

The United States leads the world in the production of swine. In an official estimate of January 1, 1915, she is credited with 64,618,000, which is more than three times as many as Germany, her nearest competitor. In the United States swine are produced chiefly in the central section of the country, generally spoken of as the "corn belt". This is largely due to the profitable returns made from corn when it is fed to swine. Sixteen per cent of the nutrients of corn fed to the average hog is returned in pork, while only three per cent is returned in beef.

The accompanying chart showing a correlation by states of hogs and corn, also shows the leading states in hog production. A second chart shows a correlation by states between farm land values and numbers of hogs. On the whole, the numbers of swine are greatest where farm land values are highest.

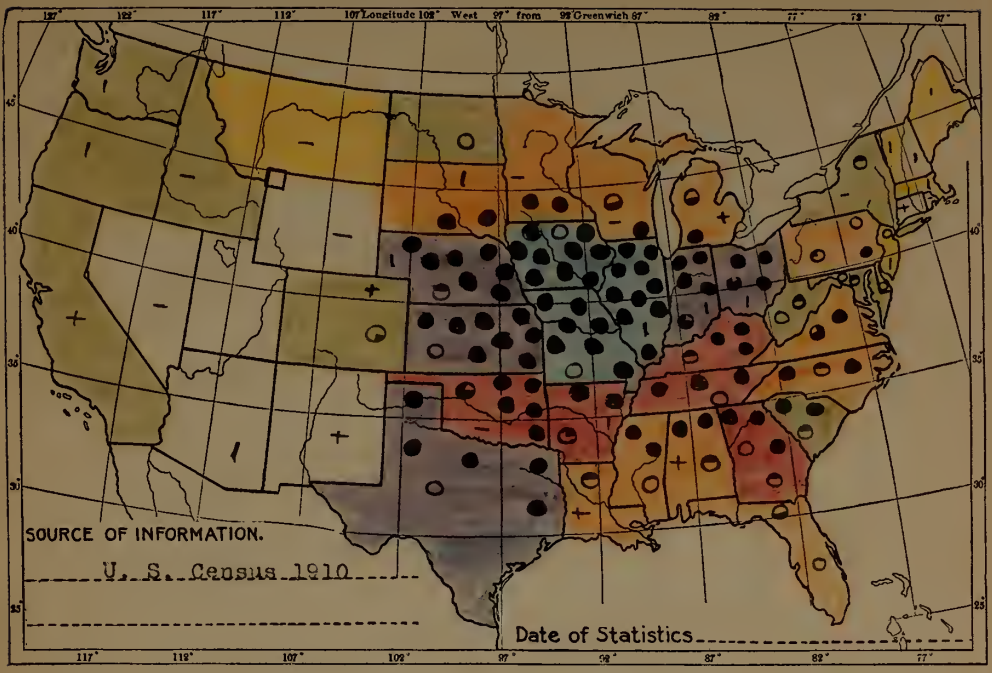
The United States as a unit, must in the future, produce more swine. It has been the experience of other nations that, in the event of a necessity for intensive agriculture, the hog has been the one animal producing meat which could fit into that practice. The right to occupy that place has been granted to the hog because of its ability to utilize cheap foods; the relatively short time required to produce a finished carcass; its economy in the use of feeds; its ability to stand close confinement, and the many methods which may be employed in preserving its carcass for future use.

The slaughter houses of New England handle some 2,000,000 hog carcasses annually, of which 500,000 only, are produced locally.

The present demand for dressed meats of all kinds has led the New England farmer to require definite and accurate information on the various practices of pork production which are applicable to his conditions. Such information has been either very scarce or unavailable in the past. In view of this fact, and a growing demand for work conducted under New England conditions, the following feeding trials were conducted. The results and conclusions drawn are timely and should prove of some value to present day feeders.

MAP NO. 1 Student's Name E. E. Fish.

Subject Correlation of hogs and corn.



Explanation

Corn Acreage, 1909.

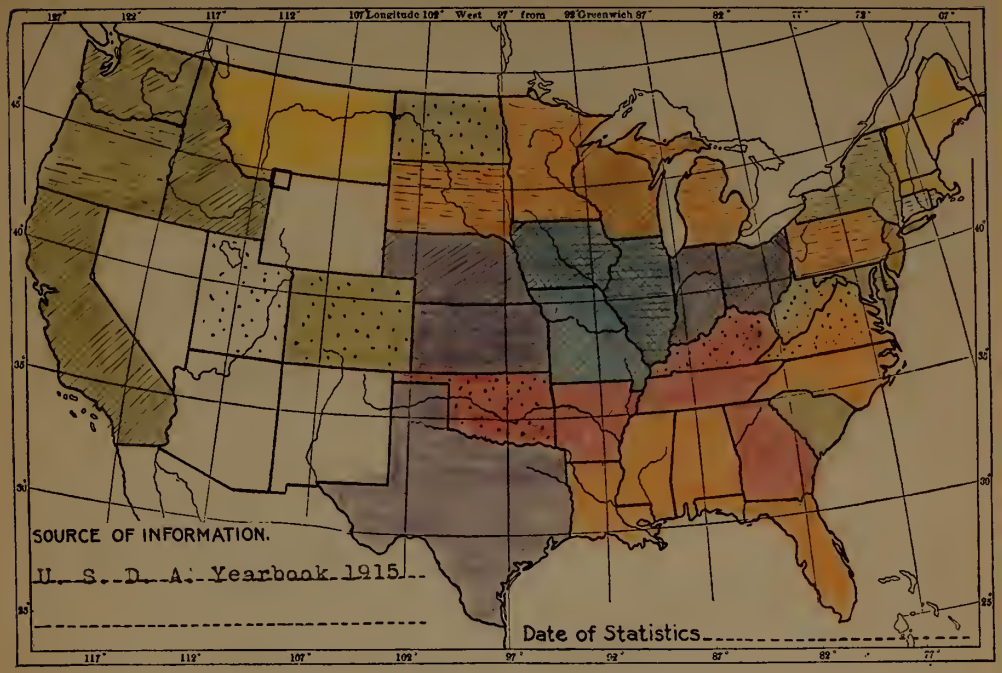
●= 1,000,000 acres.
◐= 500,000 "
◕= 750,000 "
◔= 250,000 "
0= Less than 250,000
+= " " 100,000
|= " " 50,000
-= " " 15,000

Swine--Census, 1910.
(Excluding Spring Pigs)

= Over 2,500,000
= " 1,500,000
= " 1,000,000
= " 500,000
= " 100,000
= " 50,000
= Under 50,000

MAP NO. 2. Student's Name E. E. Fish.

Subject Correlation between farm land values and swine.



Explanation

Farm ~~Property~~ Land Value

- Over $75.00 per acre
- Over $50.00 per acre
- Over $40.00 per acre
- Over $30.00 per acre
- Over $20.00 per acre
- Under $20.00 per acre

Swine

- Over 2,500,000
- Over 1,500,000
- Over 1,000,000
- Over 500,000
- Over 100,000
- Over 50,000
- Under 50,000

Experimental Work Reviewed.

Work conducted by Emil Theodor Von Wolff in 1876, at Berlin, is probably the oldest experimental work with swine that is considered of value to-day. These trials were to determine the digestibility of feeds and not to determine the relative gains upon various rations.

The pioneer work in determining the values of different rations was conducted by Goessman (1) at the Massachusetts Station at Amherst, in 1882. This was the first of a series of trials in which the values of skim milk and creamery buttermilk were compared.

The first work in which green feeds were used in connection with concentrates was reported by Shaw (2) of the Ontario Station, in 1890. Very shortly after, Morrow, at the Illinois Station, (3) reported some work with pasture, which was used very much as we use it to-day.

Wyvard of the Iowa Station is generally held to be the early advocate of the self-feeder system for supplying concentrates to swine.

Experiment Classification

Swine feeding experiments may be sub-divided according to the general plan that is followed in carrying them out. The more important sub-divisions are:

1. Breed comparisons.
2. Cooked feeds versus dry feeds.
3. Soaked feeds versus dry feeds.
4. Wide versus narrow rations.

5. Grain feeding under dry-lot conditions.
   (a) Carbohydrate feed comparisons.
   (b) Milk supplements to grain.
   (c) Various protein supplements.
6. Comparative values of feeds when used under similar pasturage conditions.
7. Relative values of various pasture and forage crops when fed with standard grain feeds.
8. Pasture versus soiling.
9. Full ration on pasture versus limited.
10. Harvesting crops with swine as against usual methods.
11. Hand feeding versus self-feeders.

The experimental work has been taken up largely in the order listed above. Rather definite conclusions have been reached for the first three mentioned phases. The values of such feeds as corn, wheat, barley, oats etc., have been fairly well established. There are certain by-products of the above grains, as well as other feeds, which, for economic reasons, have not been generally used in swine feeding work, the values of which are in dispute. Experiments to determine the values will continue to be made, under varying conditions, until a definite basis of comparison for the feed has been established.

Individual results of the many valuable experiments cannot be included in this short paper. A summary of the generally accepted conclusions of the various divisions of the work previously outlined will be of interest.

Numerous trials have been conducted on breed comparisons, notably by the Maine, Michigan, Ontario, Iowa and Massachusetts Stations. They all substantiate , for the most part, the statement made in 1891 by Dr. Goessman of the Massachusetts Station (5) that, "the differences between animals of various breeds is no wider than the differences between animals of the same breed."

Stations reporting trials on cooking feeds, after considering costs and labor, conclude in favor of uncooked feeds. A few feeds, such as potatoes and beans, may be rendered more palatable by cooking, but make expensive gains.

Results are somewhat conflicting on the desirability of soaking feeds. It is very often favored, especially in the case of meal. There is more tendency for pigs to waste dry meal than wet meal. This is shown to some extent in the relatively higher grain requirements for one hundred pounds gain in experiments where self-feeders are used.

Work at the Wisconsin, Connecticut, Massachusetts, and other Stations shows a proportion of one part of skim milk or buttermilk to three or four parts of grain to be the most advantageous.

Probably more work has been done in comparing various grain feeds than any other line of swine feeding work. Among carbohydrate feeds, corn and its by-products, such as hominy meal, takes first rank. Hominy meal is usually preferred to corn meal because it is somewhat lighter in texture and is higher in protein and fat analysis. Various other carbohydrate feeds, used in many restricted sections are wheat, mostly shrunken or frosted, rye, barley, buckwheat, and kaffir corn. Definite comparisons of these feeds with corn are somewhat lacking.

But little difference has been found between sweet skim milk, sour skim milk, or butter-milk. They has been used to advantage and is generally concluded to have one-half the value of skim milk.

In comparing various protein supplements, the field is divided between animal and vegetable products. Digester tankage and blood meal are most favored among the former and oil meal and wheat middlings among the latter.

Under pasture conditions pigs require quite different methods of feeding and other grain supplements than would the same pigs in dry lots. This is not constant for all kinds of pastures, and in some cases is not constant for the same pastures under dissimilar weather conditions. There is not much reliable data on the use of different feeds under similar pasturage conditions because of the difficulty in securing like pasturage conditions. Chemical analysis of the composition of the green plants has usually been accepted as a safe basis for determining grain rations.

The working out of the proper forage plants to use with standard grain rations is largely a matter of sectional selection. Local conditions of weather, soil, drainage, and moisture make this necessary. Crops suited for one section are not profitable in others.

The use of a soiling crop enables the farmer to secure a much larger amount of green material for a limited area than he would if the same area were pastured. The limiting factors for the two systems are: cost of handling and available space. Usually the cost of handling is the larger factor, hence pasture crops are advocated.

Work conducted at the Utah, Illinois, Iowa, Missouri and other stations gives rise to the belief that it is more economical to

limit the amount of grain that swine receive on pasture. While they do not make large gains for the length of time pastured, they are obliged to make better use of the forage crop.

The chief crops harvested with swine have been corn and rye. Some other small grains have been tried, but this has not been found to be a profitable procedure except where it is impossible to harvest the crop in the usual manner. Corn belt farmers find that a small patch of corn can be harvested by well developed pigs to good advantage. Farmers throughout the east are usually limited in their corn supply and can make better use of the crop for ensilage or fodder.

Experiments comparing self-feeders with the usual hand feeding methods are comparatively few and recent. The chief end reached thus far has been a recognition of the possibilities of the feeder method. Work has been divided between two methods of self-feeding. One method is to allow the pigs access to a number of different grains so they may balance their own ration according to their wants. By the other system a mixture of grains is placed before them. Recent work seems to indicate that self-feeders have many limitations.

Winter Feeding Experiments.

The following experiments were outlined with definite objects in view. The results thus far secured, have given promise of definite conclusions. Further work along these same lines will be necessary before more than indications can be stated.

Object of Experiments.

1. To determine the relative merits of corn meal and rye meal as fattening feeds for swine.
2. To determine the relative values of red-dog flour and wheat middlings in the rations.
3. To determine the feeding value of blood meal as a supplement to the corn meal ration.
4. To determine the value of garbage tankage as a corn supplement.
5. To point out the more economical fattening rations under New England conditions.
6. To note the palatability of the various rations and their effect upon the general health of the animals.

General Plan of Experiments.

The pigs were divided into lots of five each, and so far as possible, were started at the same time under the same housing conditions. Pigs were weighed at the beginning of the experiment and individual weights obtained once each week as long as the experiment was continued. All feed was weighed at the time of feeding which was twice daily. Salt was used in the rations and charcoal was furnished the pigs at irregular intervals. The pigs were for the most part a cross between Berkshire and Large Yorkshire. They were taken collectively and represented an average similar to that of all farm litters. The pigs were fed according to their appetites; and changes in the amounts of feed allowed were made at the regular weighing periods except in special cases where the animals were observed to go off feed.

Important features brought out by these tests.

Data, about to be presented, shows that in these experiments, rye meal does not measure up to corn meal in pork producing value. This corresponds to Danish results (7) when feeding pigs for bacon. Its value for pork production has not previously been reported in this country.

Garbage tankage used in these experiments proved very unsatisfactory and its value in the swine ration is doubtful.

With corn and hominy meal costing $31.00, Red Dog flour $31.25, wheat middlings $20.00, Blood meal $60.00, and digester tankage $45.00 per ton; skim milk costing 40¢ per hundred pounds was found to be an economical feed to use as a protein supplement.

Blood meal, one of the lesser known protein supplements, proved economical and produced very satisfactory gains.

TABLE No. 1

Pigs on Rye - Middlings - Skim Milk Feed.
Proportion: 1-1-6.

Pig	No.1	No.2	No.3	No.4	No.5	Average
Initial weight, pounds....	97	82	114	89	93	95
Final weight, pounds.....	158	135	179	161	158	158.2
Total gain, each.....	61	53	65	72	65	63.2
Average gain per day.....	.984	.855	1.05	1.16	1.05	1.02
Days fed.....						62
No. lbs middlings fed.....						108.4
Cost of middlings @ $28.00						1.52
No. lbs. rye meal fed.....						108.4
Cost of rye meal @ $35.00						1.90
No. lbs. skim milk fed....						650.4
Cost of milk @ 40¢ per cwt						2.60
Cost per lb. gain.....	.099	.114	.093	.084	.093	.095
Total cost of feed.....	$6.02	$6.02	$6.02	$6.02	$6.02	$6.02
Value of gain @.093¢ per lb	5.67	4.93	6.05	6.70	6.05	5.88
Profit above feed cost....	-.35	-1.09	.03	.68	.03	-.14

Note: Average live weight selling price for all pigs marketed.

These pigs were in a healthy condition at all times and were not observed to go off feed. It was necessary to discontinue the experiment at the end of sixty-two days because it was impossible to obtain more rye meal. The original meal came from seed rye which was ground locally for the experiment.

TABLE No. 2.

Corn - Middlings - Skim Milk Feed, (62 days).

Proportion: 1-1-6

Pig	No.1	No.2	No.3	No.4	No.5	Average
Initial weight, pounds	81	78	75	74	78	77.2
Final weight, pounds	137	151	146	144	143	144.2
Total gain	56	73	71	70	65	67
Average gain per day	.903	1.18	1.14	1.12	1.05	1.08
No. of days fed	62	62	62	62	62	62
No. of pounds middlings fed						1036
Cost of middlings @ $28.00						1.45
No. lbs corn meal fed						103.6
Cost of corn meal at $31.00						1.61
No. lbs. skim milk fed						621.6
Cost of milk at 40¢ per cwt						2.49
Total cost of feeds	$5.55	$5.55	$5.55	$5.55	$5.55	$5.55
Cost per pound gain	.099	.076	.078	.079	.085	.083
Value of gain @ .093 per lb	5.21	6.79	6.60	6.51	6.05	6.23
Profit above feed cost	-.34	1.24	1.05	.96	.50	.69

These figures show the results of the first sixty-two days of the experiment for comparison with rye meal lot. The experiment was continued for forty-three days longer and the results shown in table three.

TABLE No. 3.

Pigs on Corn - Middlings - Skim milk Feed. (Complete Experiment)

Proportion: 1-1-6.

Pig	No.1	No.2	No.3	No.4	No.5	Average
Initial weight, pounds,...	81	78	75	74	78	77.2
Final weight, pounds.....	194	219	220	215	212	212
Total gain.....	113	141	145	141	134	131.8
Average gain per day.....	1.076	1.343	1.381	1.343	1.276	1.384
No. of days fed.....	105	105	105	105	105	105
No. lbs middlings fed.....						204.4
Cost of middlings @ $20.00:						2.66
No. lbs corn meal fed.....						204.4
Cost of corn meal @ $31.00:						3.17
No. lbs. skim milk fed....						1220.8
Cost of milk @40¢ per cwt.:						4.88
Total cost of feed.....	$10.71	$10.71	$10.71	$10.71	$10.71	$10.71
Cost per pound gain.....	.0948	.076	.074	.076	.080	.0794
Value of gain @.093 per lb.	10.51	13.11	13.49	13.11	12.46	12.54
Profit above feed cost....	-.20	2.30	2.78	2.30	1.75	1.83

In studying the data from this experiment, it will be noticed that the pigs in the corn-middlings-milk fed lot made higher daily gains and higher total gains each, than did the pigs on the rye-middlings-milk ration. At the beginning of the experiment the rye fed pigs were heavier which is considered an advantage for the production of high daily gains. There was no tendency for either lot to go off feed or show any ill effects from the feed. Higher costs per pound gain resulted with the rye fed lot. This was due to a lower daily gain; to a greater grain consumption per pig; and to a higher cost per ton for the rye meal as compared to the corn meal.

This experiment shows, in the mind of the author, that where rye is grown on the farm, it may well be used as a pig food if its market value is ten or more per cent lower than that of corn. Otherwise, it would seem more profitable, as would have been possible in this case, to sell the rye and purchase corn meal.

An interesting feature is brought out by a comparison of tables No. 2 and 3. In the latter it will be noticed that the average gain per day was higher and the cost per pound gain was lower, in each case where the pigs were carried for a longer period. This shows the advantage of carrying pigs on a desirable ration for a long period of time to get favorable results and to determine the full feeding value of the ration.

TABLE NO. 4.

Ration { Red Dog flour 1 part
Corn meal 2 parts
Skim milk 9 parts

Pig	No.1	No.2	No.3	No.4	No. 5	Average
Initial weight, pounds	98	67	73	88	77	80.6
Final weight, "	250	152	175	236	186	200
Total gain, pounds	152	85	102	148	109	119.4
Average gain per day	1.45	.81	.971	1.41	1.038	1.135
No. of days fed						105
Red Dog flour fed, lbs						102
Cost of flour @ $31.25 .ton.						1.59
Corn meal fed, lbs						2.03
Cost of corn meal @ $31.00						3.15
Skim milk fed, lbs						924
Cost of milk @ 40¢ per cwt						3.70
Total cost of feed	$8.44	$8.44	$8.44	$8.44	$8.44	$8.44
Cost per gain lb	.055	.099	.083	.057	.077	.07
Value of gain @ .093 per lb	14.14	7.91	9.49	13.76	10.14	11.10
Profit above feed cost	5.70	-.53	1.05	5.32	1.70	2.66

TABLE No. 5.

Ration { Hominy 4.6
Wheat Middlings 2.3
Digester Tankage 1.

Note: after the first fourteen days, skim milk was added; 2 to 1 of grain.

Pig	No.1	No.2	No.3	No.4	Average
Initial weight, lbs.	83	78	95	99	88.75
Final weight, lbs.	167	161	175	162	166.5
Total gain	84	83	80	63	77.5
Average gain per day	1.5	1.48	1.43	1.13	1.38
Days fed					56
Hominy meal fed, lbs.					136
Cost of hominy @ $31.00, ton:					$2.11
Wheat middlings fed, lbs.					68
Cost wheat middlings @ $28.00					.95
Digester tankage fed, lbs.					29
Cost of tankage @ $40.00, ton:					.58
Skim milk fed, lbs.					294
Cost of milk @ 40¢ per cwt.					$1.18
Total feed cost	$4.82	$ 4.82	$4.82	$4.82	$4.82
Cost per pound gain	.057	.058	.06	.076	.062
Value of gain @ $.093 per lb:	$7.81	$ 7.72	$7.44	$5.86	$7.21
Profit above feed cost	2.99	2.90	2.62	1.04	2.39

No direct comparison of results can be made between the two rations reported in tables 4 and 5. Taken individually, both show some satisfactory and economical gains. One pig in lot 4, namely; pig No.2, showed a tendency to go off feed, and did not make the use of this that the others did. The same ration was tried on some younger pigs with smaller initial weights previous to starting this trial, and was found unsatisfactory. When a full feed was allowed the animals scoured badly and had to be discontinued.

All the animals did well in lot No. 5 and the table is of value in showing the results obtained where a ration of recognized merit was used.

Lot No. 6.

Ration (Digester Tankage 1
(Hominy meal 9

Pig	No.1	No.2	No.3	No.4	No.5	Average.
Initial weight, lbs.	51	51.	55	59	60	56
Final weight, lbs.	94	88	102	98	112	99
Total gain	43	37	44	39	52	43
Average gain per day	1.02	.88	1.05	.93	1.24	1.02
Number of days fed	42	42	42	42	42	42
Hominy meal, lbs. fed						1285
Cost Hominy @ $31.00 per ton						1.99
Digester tankage fed, lbs.						14.3
Cost of tankage @ $40.00 ton						.29
Total cost of feed	$2.28	$2.28	$2.28	$2.28	$2.28	$2.28
Cost per pound gain	.053	.062	.052	.058	.044	.053
Value of gain @ $.093 per lb.	4.00	3.44	4.09	3.63	4.84	4.00
Profit above feed cost	1.72	1.16	1.81	1.35	2.56	1.72

Table No. 7.

Ration { Garbage Tankage 1
{ Hominy meal 5

Pig	No.1	No2.	No.3	No.4	No.5	Average
Initial weight, lbs.....:	91	91	87	62	92	84.6
Final weight, lbs.....:	145	173	167	110	132	145.4
Total gain, lbs.....:	54	82	80	48	40	60.8
Average gain per day,lbs.:	.7	1.065	1.04	.623	.52	.8
Number of days fed :						77
Hominy meal, lbs fed.....:						375.4
Cost hominy @ $31.00,ton :						$4.87
Garbage tankage fed, lbs.:						55
Cost tankage @ $20.00, ton:						.55
Total cost of feed.....:	$4.82	$4.82	$4.82	$4.82	$4.82	$4.82
Cost per pound gain.....:	.09	.0588	.06	.10.04	.12.05	.0792
Value of gain @ $.093, lb.:	5.02	7.63	7.44	4.46	3.72	5.65
Profit above feed cost...:	.20	2.81	2.62	-.36	-1.10	.83

Lot No. 8.

Ration { Corn meal 9 parts
{ Garbage tankage 1 part.

Pig	No.1	No.2	No.3	No.4	No5.	Average
Initial weight, lbs.....:	60	65	119	63	74	76.2
Final weight, lbs.....:	70	90.5	136	71	89.5	91.4
Gain for the period, lbs.:	10	25.5	17	8	15.5	15.2
Gain per day.....:	.24	.607	.405	.19	.37	.314
Number of days fed.....:						42
Amount consumed per pig...:						138
Amount consumed per day...:						3.29
Am't of feed per lb. gain :	13.8	5.41	8.1	17.25	8.9	9.1
Cost of feed per pig.....:	$2.08	$2.08	$2.08	$2.08	$2.08	$2.08
Cost of feed per lb.gain..:	.21	.081	.12	.26	.134	.131
Value of gain at .093 gal.:	.93	2.37	1.58	.74	1.44	1.41
Profit above feed cost....:	-1.15	.29	-.50	-1.34	-.64	-.67

TABLE No. 9.

Ration (Corn meal 9 parts
(Digester tankage 1 Part.

Pig	No.1	No.2	No.3	No. 4	No.5	Average
Initial weight, lbs.	70	91	135	71	90	91.4
Final weight, lbs.	93	112	162	103	134	140.8
Gain for period, lbs.	24	21	27	32	44	29.4
Ave. gain per day , lbs.	.66	.60	.77	.91	1.26	.84
Days fed						35
Amt of feed per pig,lbs.						124
Am't feed per day per pig						3.54
Am't feed per lb. gain	5.33	5.9	4.6	3.9	2.8	4.22
Cost of feed per pig	2.03	2.03	2.03	2.03	2.03	2.03
Cost of feed per lb. gain	.09	.097	.075	.063	.046	.07
Value of gain at.09$ lb.	2.14	1.95	2.51	2.98	4.09	2.73
Profit above feed cost.	,11	-.08	.48	.95	2.06	.67

In comparing digester tankage with garbage tankage as shown in tables six and seven, some striking differences are noted. The pigs at the beginning of the experiment on garbage tankage were older and further developed than those on the digester tankage and should have shown better gains, relatively, if the ration was good. It is clearly shown that only two pigs were able to make better gains than the poorest gain in the digester tankage lot. The garbage tankage lot was continued for a longer period of time. Before pigs on the latter ration had passed the thirty-five day period, it was noticed that they were growing long and thin and seemed to desire something that was not furnished in the ration. They received the same treatment with mineral matter as other lots.

In order to further substantiate these results, further experiments as shown in tables eight and nine were carried on. This experiment was conducted somewhat differently. The pigs were carried for forty-two days on the ration of corn meal nine, garbage tankage one, and then digester tankage was substituted for the garbage tankage and the pigs continued for thirty-five days longer. The pigs were fed by means of a self-feeder. The garbage tankage was found to be acid in reaction hence three pounds of finely ground limestone was added to each 100 pounds of the grain mixture. This was also continued when digester tankage was substituted.

While good gains were not recorded in either of these experiments, the results show that the ration containing the digester tankage instead of the garbage tankage, was vastly superior. The general appearance and bearing of the animals also warranted this statement.

These animals were self-fed in limited quarters. In the mind of the operator, this combination of feeds was not suited for the best results from this method. A ration with some wheat middlings replacing part of the corn meal has given much better results under similar conditions at the Missouri Station (3). The pigs were given free access to the feeder at all times and cold water was present in the trough.

A comparison of the analyses of the two brands of tankage shows as follows:

	Water	Ash	Protein	Fiber	Fat
Garbage tankage	8.58	14.38	30.14	8.65	1.53
Lowell, Bone and Meat Meal	3.66	43.50	36.07	----	7.57

TABLE No. 10

Ration (Yellow Hominy 10 parts
(Blood meal 1 part

Pig	No.1	No.2	No.3	No.4	No.5	Average
Initial weight, lbs.	90	102	93	82		91.75
Final weight, lbs.	191	168	198	189		186.5
Total gain, each, lbs.	101	66	105	107		94.75
Average daily gain, lbs.	1.2	.79	1.25	1.27		1.13
Number of days fed						84
Number lbs. hominy fed						4123
Cost of hominy @$31.00, ton						6.39
No. pounds of blood mealfed						34
Cost of blood meal @ $60.00						1.02
Total cost of feed	$ 7.41	$7.41	$7.41	$7.41		$7.41
Cost per lb. gain	.073	.112	.0705	.0692		.078
Value of gain at .093¢ lb	$9.39	$6.14	$9.77	$9.95		$8.82
Profit above cost	$1.98	$-1.27	$2.36	$2.54		$1.41

Note: For two weeks, due to lack of blood meal(28th day to 42nd day) hominy alone was fed.

TABLE NO. 11

Ration { Yellow hominy ten parts
Blood meal one part

Pig	No.1	No.2	No.3	No.4	Average
Initial weight, lbs.	127	139	104	115	122
Final weight, lbs.	239	263	187	214	226
Total gain, lbs.	112	124	83	96	104
Average daily gain, lbs.	1.33	1.48	1.00	1.14	1.235
No. of days fed					84
Am't of hominy meal fed					412.3
Cost hominy meal @ $31.00					$6.39
Am't blood meal fed, lbs					34
Cost of blood meal @$60.00					$1.02
Total cost of feed	$7.41	$7.41	$7.41	$7.41	$7.41
Cost per pound gain	.066	.66	.089	.077	.071
Value of gain @93¢ per lb	10.42	11.53	7.72	8.93	9.67
Profit above cost	3.01	4.12	.31	1.52	2.26

Note: For two weeks, due to lack of blood meal, (28th day to 42nd day) hominy alone was fed.

The feeding of blood meal for protein supplement proved very satisfactory so far as the general health of the animals was concerned. Both lots were fed at the same time and given the same amounts of feed. All animals made uniform gains and showed no tendencies to go off feed. The blood meal is a very high protein food, guaranteed to contain at least 80% protein. Hence smaller amounts may be used with the corn or hominy to make a balanced ration than in the case of the digester tankage. The digester tankage was a rather low protein feed as compardd to some used by other investigators. This tankage is guaranteed to contain 35 to 45% protein and 8 to 12% fat.

Prices for Grain

The prices for grain used in figuring these results are as follows:

Corn meal	$31.00	per ton
Red Dog flour	31.25	" "
Hominy meal	31.00	" "
Wheat middlings	26.00	" "
Digester tankage	45.00	" "
Garbage tankage	20.00	" "
Skim milk	.40	" Cwt.
Blood meal	60.00	" ton

SUMMARY

Results of Winter Feeding Work,

1915-16 and 1916-17.

Part One.

:Rye 1 :Middl 1 :Milk 6	:Corn 1 :Middl 1 :Milk 6	:Middl 1 :Corn 1 :Milk 3	:Red Dog 1 :Corn 2 :Milk 9	:Corn 4.6 :Middl 2.3 :Tmk. 1 :(Tk. Milk	:Oat. 9 :Tmk. 1 :Digest)

Table	No.1	No. 2 #	No.3 #	No. 4	No.5	No. 6
Initial weight:	95	77.2	77.2	80.6	88.7	56
Final weight..:	158	144.2	212	200	166.5	99
Days fed.....:	62	62	105	105	56	42
Gain per day each	1.02	1.08	1.284	1.135	1.38	1.02
No. lbs grain per day...:	3.5	3.34	3.8	2.9	4.16	3.4
No. lbs milk per day...:	10.5	10	11.4	8.8	5.25	
No. lbs grain per lb. gain..:	3.43	3.1	3.03	2.6	3.0	3.32
No, lbs. milk per lb. gain..:	10.3	9.2	9.09	7,7	3.8	
Cost per lb. grain	.0953	.083	.0794	.07	.062	.053
No. pigs in experiment	5	5	5	5	4	5

Same pigs ,Table 2 figured for direct comparison with Table 1.

SUMMARY.

Results of Winter Feeding Work.

1915-16 and 1916-17.

Part two.

Table	No.7	No.8##	No.9##	No.10	No.11
	Corn 5: Tank 1: (Garbage)	Corn 9 Tank. 1 (Garbage)	Corn 9 Tank. 1 (Digest)	Corn 10 Blood Meal 1	Corn. 10 Blood Meal 1
Initial weight.....	84.6	76.2	91.4	91.7	122
Final weight.....	154.4	91.4	140.8	186.5	226
Days fed.....	77	42	35	84	84
Gain per day each.....	0.8	.314	.84	1.13	1.235
No. lbs grain per day	4.0	3.29	3.54	5.31	5.31
No. lbs. grain per lb. gain..	5.4	9.1	4.22	4.7	4.3
Cost per lb. gain.....	.0792	.171	.07	.078	.071
No. pigs in experiment	5	5	5	4	4

Same pigs. Pigs in Table 9 continued from Table 8.

PART TWO

x
xxx
xxxxxxx
xxxxxxxxxxx
xxxxxxx
xxx
x

FODDER FORAGE CROP

EXPERIMENTS.

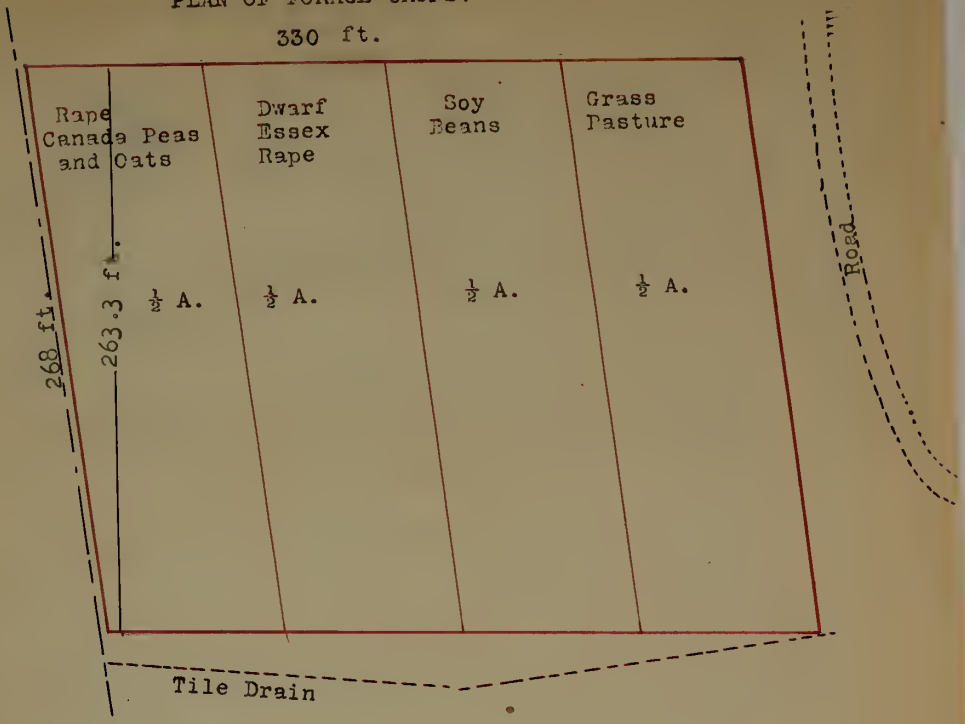
x
xxx
xxxxxxx
xxxxxxxxxxx
xxxxxxx
xxx
x

[illegible].

[illegible] Forage Crop Experiments.

Requests are continually being made for definite data concerning forage crops for swine under New England conditions. Most of these values have not, heretofore, been published, hence it seemed advisable to outline a series of experiments with various forage and pasture crops, that will be valuable from the producers standpoint. The work was carried on during the summer of 1918 and the results are contained in this paper.

PLAN OF FORAGE CROPS.



Fertilization.

All plots were one-half acre each in extent. The land was comparatively new, having been plowed but three times since it was cleared. It had been in sod for four seasons previous, and was plowed in the spring before planting. The plots were somewhat rolling; fairly well drained and above the average in fertility. The soil is heavy and has a tendency to be "cold" in the spring. A top-dressing of fresh cow-manure at the rate of twenty loads to the acre was applied previous to plowing. This manure was light and carried a large percentage of wood shavings which are used for bedding at the College farm.

The four cultivated plots were treated with 1000 pounds of ground limestone each, on May 19th. At the same time, acid phosphate at the rate of 200 pounds for each lot was applied. No commercial fertilizer or lime was applied to the blue-grass pasture plot. This was the original sod, the plot remaining unplowed.

That it pays to fertilize forage crops is fairly well established by Snyder of the Minnesota Station. He shows that forage crops differ not only in yield or the number of tons of fodder produced per acre, but also in feeding quality based on the amount of valuable nutrients contained. The observation was made in these investigations that forage crops, when grown on well-cultivated, fertile lands, often contain from 25 to 30% more protein and a smaller amount of crude fiber than when grown on poor soil. A study of rape in this connection showed that plants grown on manured lands contained 4.61 per cent more protein than those grown on un-manured lands.

CROPS

The crops grown were all in good condition, yielded an abundant amount of forage, as the accompanying photograph indicates, and for feeding purposes were excellent.

Blue grass pasture during the early part of the test.

Soy beans at the time the pigs were first pastured.

Rape from this time on furnished green feed for 112 days.

Crop	No. of Pigs Ave. for season	Rate of Seeding	Size of Plot	Date of Seeding	Date first Pastured	Length of Pasture Period
Grass pasture	12.5		.5 a.		June 24	100 days
Soy Beans	13	20."	.5 a.	May 20	Aug. 5	56 "
Dwf. Essex Rape	10	1.75"	.5 a.	May 20	July15	142 "
Canada Peas, Oats and Rape	11.5	.75 bu. .75 bu. 1 lb.	.5 a.	May 25	Aug. 5	98 "

The soy beans and rape plots were seeded in rows, 28 inches apart. The grass plot, it will be noticed was not pastured until June 24, due to scarcity of fencing material. By that time much of it was too mature for the young pigs, hence on July 12 a mowing was made and about one-half ton of hay removed. It is very probable the results from the bluegrass pasture would be of much more value if an earlier use could have been made. The season was favorable for bluegrass; at no time was there a prolonged dry season and plenty of forage was apparently present all of the time.

Late in the fall when the pigs were removed because of frozen ground, it was noticed that the pasture was more abundant and in better condition than surrounding areas which had not been pastured so intensively. This shows the effect of the extra fertilizer furnished by the grazing pigs.

The results from the soy bean lot are rather disappointing. An excellent stand of beans was secured. Pigs were turned in at the time the beans were in full blossom. At the end of three weeks it was found that ten of the pigs were not utilizing to advantage the amount of forage present. Accordingly six larger

pigs, purebred Yorkshires, which had not previously been on the experiment, were added to the lot. A small grain feeder was being used which was not large enough to accommodate the total number of pigs present. At the next weighing period it was found that the smaller pigs had failed to gain. The larger pigs had eaten grain in preference to the green forage, and further record was found to be valueless. It was significant, however, that soon after the beans were broken down and defoliated, they did not recover and produce new foliage. Hence in a relatively short time, the pigs had to be removed and were used to help utilize the forage present in the other lots.

From the forage crop point of view the rape was most satisfactory. An even stand over the entire lot was secured. When grazed down to the root stalk it still continued to send out foliage. On the back side of the lot the plants were not grazed appreciably during the early part of the experiment, as there were not enough pigs to utilize all the forage. None of these plants, however, became so tough or fibrous that they were not ultimately consumed. The plants continued to furnish foliage up to the time the ground was frozen.

The pea, oats and rape mixture proved to be fairly satisfactory, but chiefly because of its rape content. Pigs were first turned in the plot when the peas were in blossom. The peas very soon commenced to show the effects of grazing and when once torn down, were quick to die and rot. Much forage was lost in this way. The oats, a poor stand due to poor germination, had been

replaced by Japanese millet broadcasted over the plot and lightly harrowed in. These plants were somewhat fibrous and were not grazed materially until the peas were mostly gone. The rape by that time had had a chance to come on and furnished forage for the remainder of the experiment.

Objects of the Experiment.

To determine:

1. The carrying capacity of various forage crops.
2. The ability of forage crops to stand grazing.
3. The length of the pasturing period of various crops.
4. The influence of pasture upon the general health and thriftiness of the pigs.
5. The costs of pork production on the various crops,- also dry lot feeding in comparison.
6. The results from the use of self-feeders with forage crops.

Important Features brought out in Summer Forage Crop Experiments.

Rape pasture, all phases considered, proved the best forage crop tested. The pea-oats-rape pasture, largely because of its rape content, takes second rank.

Blue grass pasture, because of their lack of succulence during the hot summer months, caused an excessive amount of feed to be consumed per pound gain.

Soy beans and Canada peas do not reproduce foliage when once pastured and hence furnish relatively short pasturing seasons.

At the time soy beans were pastured, namely in full bloom, the stalks were tough and fibrous and were not consumed.

Self-feeders, to which the pigs are allowed unlimited access while on forage crops, led to high cost of production.

Grass Pasture Results--133 days.

	Ration Hominy 1: Midds. 1:	Ration Hominy 10: Midds. 6: Tankage 3:	Ration Schumacher 10: Tankage 1	Ration Corn meal 10 Middlings 6 Tankage 2
No. of pigs	20	10	10	10
Days fed	42	35	14	42
Initial weight pr pg.	40.9	64.4	99.7	113.6
Final wt. per pig	63.1	99.7	113.6	184.5
Gain for period, pig	22.2	35.3	13.9	70.9
Av. gain per day	.53	1.01	1.00	1.7
Av. feed per lb. gain	3.92	3.73	7.2	5.2
Av. feed per day	2.06	3.77	7.1	8.84
Total cost per pig	$1.254	$2.29	$1.70	$6.99
Av. cost per lb. gain	.056	$.0619	$.1223	$.0986

Summary of Grass Pasture Results.

In studying the individual records of the animals in this group it was noted that one pig, which was the lightest in initial weight, continued so throughout the season. Two pigs with the heaviest initial weights were decidedly heavier than the other pigs at the end of the season. This seems to indicate that they were in better condition to make the best use of their environment, perhaps to the disadvantage of the smaller animals.

While it is undoubtedly true that they ate more grain, it is impossible to figure on anything but an equal feed consumption basis in making up the feed and cost records. For this reason, results other than group figures, will in a certain sense, be misleading.

The high cost per pound gain for the pigs in this lot during the last 56 days of the trial, is largely attributed to an unpalatableness of the blue-grass which caused the pigs to subsist very largely on the grain supplement.

Pigs on Soy Beans 35 days.

Ration (Hominy 10
Middlings 6
Tankage 2

Average initial weight.....61.0
Number of days fed.....35
Average final weight.....92.7
Average gain for period.....31.9
Average daily gain..... .91
Total amount feed per pig.....107
Average feed per day..... 3.06
Av. feed for 1 lb. gain..... 3.36
Total cost of feed per pig.....1.76
Cost per lb. gain..... .0553
Number of pigs in test..... 10

Results of Soy Bean Trial.

Direct comparison with other plots is obviously unfair to this crop. The pigs were started on the beans much later in the season than were the pigs on the other forages. The pigs were not fully accustomed to their new environment. As a result, it may be seen that the pigs made less gain per day per animal. However, they ate less grain per day. This is also reflected in the amount of grain consumed per pound gained so that in the case of every animal but one, there was a very low feed cost per pound gained.

A larger feeding period seems nedessary before a relative valuation can be placed on soy beans as a forage crop.

Pigs on [illegible] 112 days.

Ration	Midd's 1 Hominy 1	Hominy 10 Midd's 6 Tankage 3	Schuler- ator 10 Tank'g 1	Corn meal 10 Midd's 6 Tankage 2
No. of pigs in test...	7	7	13	13
No. of days fed.....	21	35	14	42
Average initial weight:	47.6	66.9	96	113.2
Average final weight	66.9	103.3	113.2	173.1
Average gain, period	19.2	36.4	17.2	39.9
Av. gain per day	.91	1.04	1.32	1.42
Av. feed per lb. gain	3.63	3.83	4.04	3.77
Av. feed per day.....	3.3	4.	5.6	6.99
Cost of feed per pig..	$1.03	$2.43	$1.19	$5.68
Av. cost per lb. gained	.0534	.0668	.0687	.0947

Results of the Rape Plot.

These pigs, together with the pigs used for the pea-oat-rape plot, were lacking somewhat in uniformity and thrift, being the left-overs from the early season litters. While ten pigs were started on each plot, it was found necessary, after several weeks, to eliminate several from both plots in order to make fair comparisons.

In comparing the first feeding period on rape with the other forage crops, it must be borne in mind that the grass plot shows figures for a period twice as long as the others.

In each of the periods except the last, the gains per day were greater and the amount of feed per pound gain less(except for grass plot, 2nd period) than the other plots. This seems to show the feeding value of the rape to be greater than that of the other crops.

In studying the average for the entire summer, it is noted that the daily gains are higher and the feed and cost per pound gain are lower than the other crops considered.

As the feeding period for the rape covered approximately 142 days with an average of 10 pigs for the period, it is felt that these results are the most favorable for the season studied

Pigs on Pea - Oats - Rape Lot 98 days.

Ration	Hominy 1 Midds. 1	Hominy 10 Midds. 6 Tankage 3	Schumacher 10 Tankage 1	Corn meal 10 Midds. 6 Tankage 2
No. of pigs fed.....:	8	10	14	14
No. of days fed.. ..:	21	35	14	28
Av. initial weight..:	43.4	55.2	93.9	109.4
Av. final weight.. .:	58.8	91.	109.4	150.1
Av. gain for period.:	15.4	35.8	15.5	40.7
Av. gain per day....:	.74	1.02	1.11	1.45
Av. feed per lb. gain	4.11	3.9	4.59	4.3
Av. feed per day... :	3.1	4.0	5.2	6.2
Cost of feed per pig:	$. 94	$1.81	$1.22	$3.34
Cost per lb. gain...:	.0608	.0506	.078	.0821

Results of Pea - Oats - Rape - Plot.

Good results were shown for this plot. One individual which was heaviest at the beginning of the test was slow in making a start, but made up for it later in the experiment. This was contrary to the results secured from the heavier animals on the grass pasture. The costs per pound gain were low throughout the entire season, hence these crops gave the lowest average cost of any of the crops used.

It is noted that the average feed consumed per day for this lot was the lowest for all the periods during the feeding season.

Pigs on Dry Lot 119 days.

Ration	Hominy 1 Midds. 1	Hominy 10 Tankg. 1	Schumacher 10 Tankage 1	Corn Meal 10 Midds. 6 Tankage 2
No. of pigs in test.:	10	10	10	10
No. of days fed.....:	35	42	14	28
Av. initial weight..:	32.1	52.5	75. 9	85.5
Av. final weight....:	52.5	75.9	85.5	106.3
Av. gain per pig....:	20.4	23.4	9.6	20.8
Av. gain per day....:	.58	.557	.69	.74
Av. feed per lb. gain	3.53	4.4	6.04	4.33
Av. feed per day....:	2.06	2.46	4.14	3.2
Av. feed cost a pig :	$1.04	$1.88	$.99	$2.22
Av. cost per lb. gain	.0502	.0805	.1027	.1069

Dry Lot Results.

The gains made by these pigs, fed very much the same as pigs on the forage crops, were small but uniform in all cases.

The costs per pound gain were lower than might be expected, when compared to the lots on forage.

The chief feature shown by these pigs was the fact that they were fine boned and small by the end of the season and required a much longer time to fit for market. This is a factor which is of great importance to the farmer as it is necessary to make room for new stock as well as to receive quick returns on the investment.

General Summary of Forage Crop Experiments.

Summer of 1916.

	1st Per.	2d Per.	3d Per.	4th Per.	Ave.
Ave, gain per pig on grass, per day....	.53	1.01	1.00	1.7	1.07
Ave. gain per pig on rape.....	.92	1.04	1.32	1.42	1.17
Ave. gain per pig on peas, oats & rape	.74	1.02	1.11	1.45	1.08
Ave gain per pig on dry lot.....	.58	.557	.69	.74	.642
Ave. feed consumed per day each, grass	2.06	3.77	7.1	8.84	5.44
Ave. feed consumed per day each, rape..	3.3	4.	5.6	6.99	4.97
Ave feed consumed on peas, rape & oats..	3.1	4.	5.2	6.2	4.62
Ave. feed consumed on dry lot.....	2.06	2.46	4.14	3.2	2.97
Ave. feed consumed per lb. gain on grass	3.92	3.73	7.2	5.2	5.01
Ave feed consumed per lb. gain on rape	3.63	3.83	4.04	3.77	3.82
Ave. feed consumed per lb. gain on peas, oats, rape	4.11	3.9	4.59	4.3	4.23
Ave. feed consumed per lb. gain, dry lot	3.53	4.4	6.04	4.53	4.58
Ave. cost per lb gain on grass.....	.056	.0619	.1223	.0986	.0847
Ave. cost per lb. gain on rape..	.0534	.0668	.0927	.0947	.0709
Ave. cost per lb. gain on peas, oats, and rape.....	.0603	.0506	.078	.0821	.0679
Ave, cost per lb. gain on dry lot.....	.0562	.0805	.1027	.1069	.0851

From the standpoint of the grain rations fed it is shown that in period three, when a ration of Schumacher feed 10 parts and Tankage 1 part was used, the amount of grain consumed per pound gain was excessive in every case. The lot of pigs least affected were those on rape. This ration was quite bulky and did not prove an economical feed. A longer feeding period would be necessary to show the merits of this ration to its best advantage. As this is a wide departure from the previous and subsequent ration, it may also be offered as a criticism of the results shown.

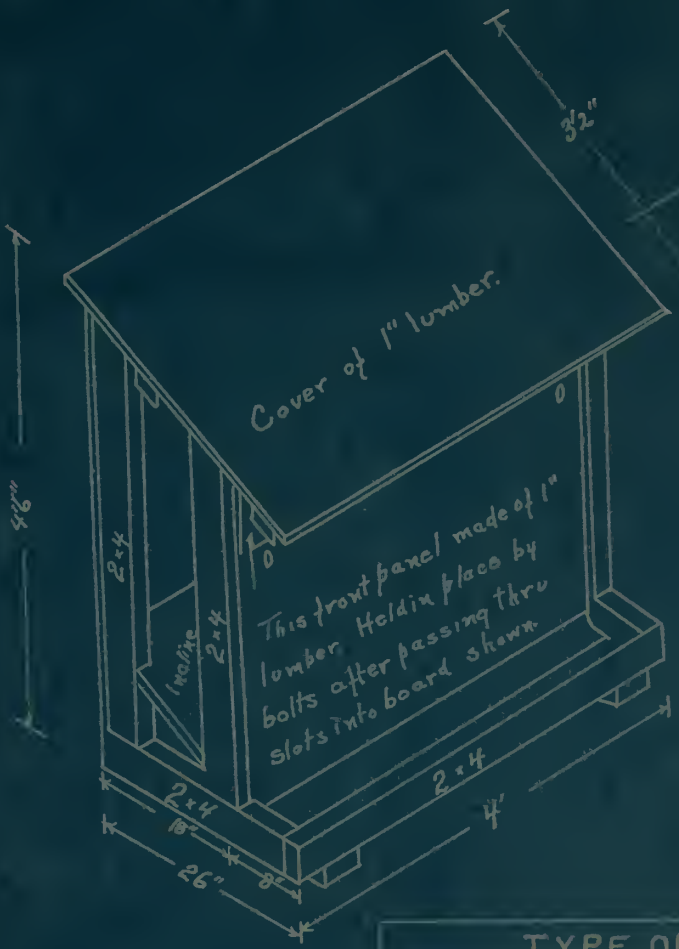
Self-feeders.

The self-feeders used in these experiments were of varying types, including several well-advertised commercial feeders. Several feeders were constructed after the plan accompanying this paper, and were found to be very satisfactory provided a platform is furnished which is large enough for the pigs to stand upon while eating.

An important feature to hold in mind where self-feeders are used, is that it is better to have too much feeder space for the number of pigs fed than the opposite, as it tends toward a much less waste of grain.

These experiments seem to indicate that for growing pigs on forage crops, it would be more economical to provide the self-feeder with a hinged door which may be let down over the feeding trough and hooked, so as to limit the grain feed to only certain portions of the day.

A blue-print showing the construction of the self-feeder built for these experiments is shown on the following sheet.



TYPE OF
SELF-FEEDER
USED IN
EXPERIMENTS.

[illegible]

[illegible]

1. The lots fed the same ration, one being fed in addition in the long or central piggery and the other fed in an open yard containing a colony house for shelter.
2. A direct comparison, the same ration being used, of three lots. Lot 1 being hand-fed with a mixed slop; lot 2 having a self-feeder with free access at all times, and lot three having a self-feeder with access only one-half time.
3. The use of a self-feeder for young, weanling pigs as against hard texture animals.
4. The use of a standard grain ration for one lot against the same ration supplemented with roots for another lot.
5. Further experiments with [illegible] flour in the ration.

[illegible]

1. On the same kind of pasture, the use of a grain supplement in self-feeder that is fairly bulky (by addition of alfalfa meal, for instance;) against the common corn and tankage supplement; same ratio.
2. The use of sweet clover as a forage crop.
3. A direct comparison, as to everyday capacity and growth, of rape sowed in drill and cultivated, as against rape broadcasted.
4. The use of drilled corn as a forage crop.

TABLE OF REFERENCE.

1. Goessman, C. A. Bul. No. 13. Massachusetts Agricultural Experiment Station, 1884.
2. Shaw, T. Bul. No. 59. Ontario Station, 1890.
3. Morrow, G. E. Bul. No. 16. Illinois Station, 1891.
4. Evvard, J. M. Corn Belt Meat Producers' Association Report, 1914.
5. Goessman, C. A. Massachusetts Station Report, 1891, Page 148
6. Copenhagen (Denmark) Reports 1887 and 1890.
7. Weaver, L. A. Missouri Station Bulletin No. 144, 1917.